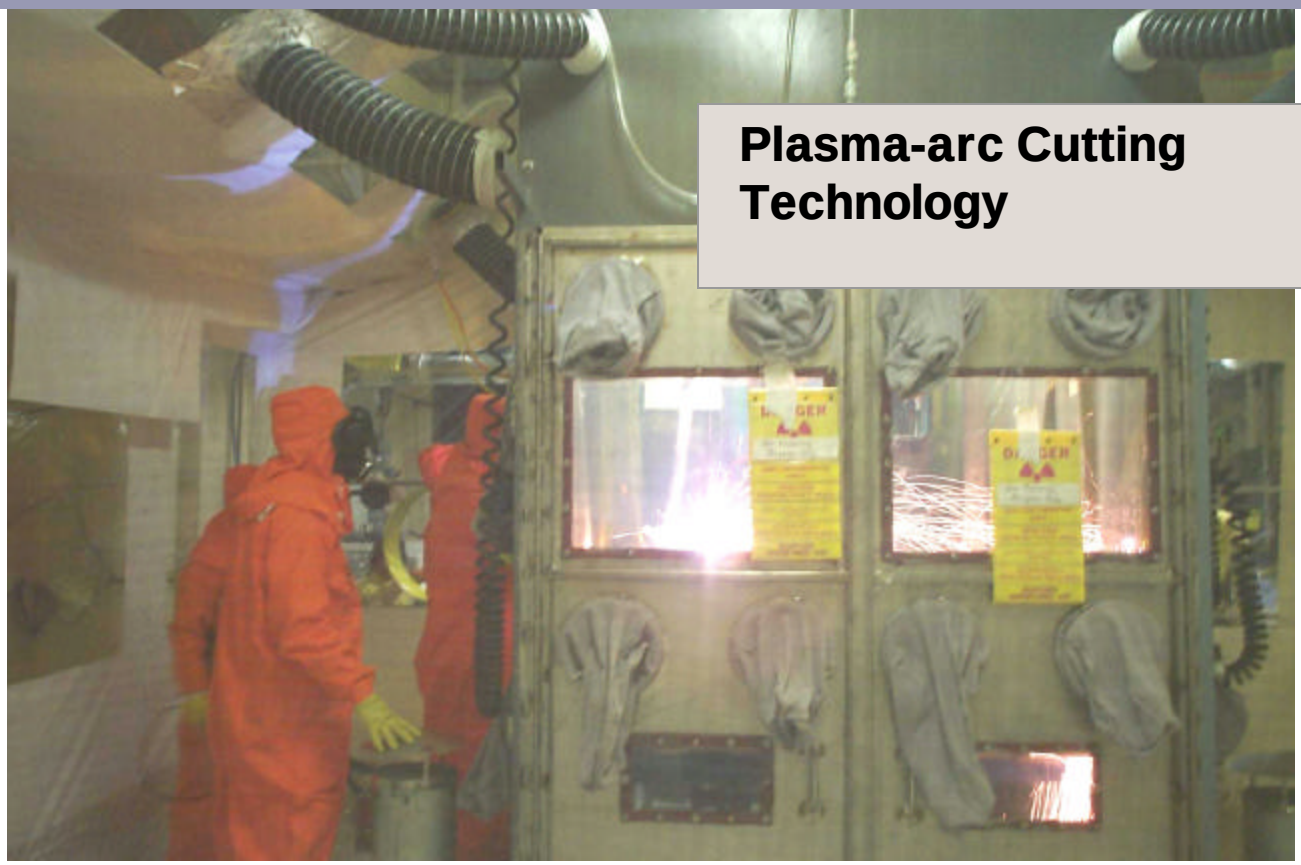
Plasma-arc Cutting Technology



Workers inside a special chamber size-reduce a glovebox using plasma-arc cutting technology.

History

During World War II, in an effort to improve the joining of aircraft materials, a method of welding was developed that used a barrier of inert gas around an electric arc to protect the weld from oxidation. This new welding method became known as *plasma-arc*.

Over the next few decades, this new technology underwent refinements, including the restriction of the opening through which the inert gas passed so as to greatly increase the heat produced. It was discovered that the smaller opening dramatically sped up the flow of gas and blew out a channel in the material affected, which resulted in a safer and simpler process for cutting iron and other metals.

Limited commercial use of the expensive plasma-arc cutting technology in the early 1960s eventually gave way to popularity as the units became more compact and affordable even for small businesses. Today, many manufacturers sell portable plasma cutters with built-in air compressors that can be carried easily on a truck to the job site.

How plasma-arc cutting works

Plasma cutters function by sending an electric arc through a gas as it passes through a constricted opening. The gas can be compressed air, nitrogen, argon, oxygen, etc. The arc elevates the temperature of the gas to the point where it enters the fourth state of matter called plasma. It is the electrical conductivity of the plasma that causes the arc to transfer to the work, while the high current causes the metal to melt. The nozzle's restricted opening causes the gas to squeeze by at a high rate of speed and cut through molten metal. The gas is also directed around the perimeter of the cutting area to shield the cut.

Plasma-arc cutting at Rocky Flats

In 1999, Rocky Flats Environmental Technology Site project managers actively pursued the use of plasma-arc cutting technology as they looked for a more effective way to cut gloveboxes, tanks, and other large equipment. Use of manual cutting tools such as nibblers and band saws to size-reduce equipment was the norm, sometimes requiring workers to don several layers of protective clothing and respirators. It was impossible to size-reduce some of the large equipment found in several nuclear buildings with the existing manual implements.

Plasma-arc technology has been deployed because it cost-effectively, efficiently, and safely solves the challenges inherent in size-reducing large equipment. By constructing a plasma-arc cutting unit inside a fully contained inner-tent

chamber, workers are able to operate the plasma cutter from outside the chamber, where they are protected from potential radiation exposure and contamination. The plasma torch is expected to reduce by half the time needed to size-reduce a comparable piece of equipment with manual tools.

Plasma-arc cutting torch.

The first plasma-arc cutting unit, a 220-volt, off-the-shelf PAC 150, was installed in Building 771 in 2000. The unit utilizes air to fuel the torch. Before it became operational, a series of tests was performed on the unit to verify its airtight character, correct airflow, and ability to consistently keep contamination inside the chamber. In addition, a comprehensive safety review for introducing an ignited source into a radiologically contaminated building was conducted successfully prior to implementation.

In preparation for the unit to "go hot" (begin cutting radioactively contaminated gloveboxes), two clean gloveboxes were introduced into the chamber. Workers were able to participate in dry runs of the procedures as well as hands-on "clean box" training with the plasma torch. (Workers entering the chamber are required to wear fireproof protective clothing and dark safety glasses to protect against ultraviolet rays.)

The next evolution

The plasma-arc cutting system began operations in early 2001. A new inner-tent chamber is currently under construction in Building 771 to house a second plasma-arc cutting unit. The newest unit, equipped with remote-control arms, will provide additional protection to workers. One arm is capable of holding the torch and cutting while a worker manipulates the arm with a joystick. A second arm grips the pieces to be cut and loads the cut pieces into a standard waste box or crate for shipping and disposal. Consequently, the workers' arms are kept out of the glovebox, further reducing the opportunity for potential contamination and assimilation of radiation doses. From an ergonomic perspective, the new unit greatly decreases physical demands on workers.

Plasma-arc cutting technology will be used effectively to cut many of the gloveboxes and tanks in Building 771/774. Similar units will likely be installed in other buildings at Rocky Flats to assist in demolition activities.

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For further information about Rocky Flats

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Also, additional information about Rocky Flats is available on the internet at: http://www.rf.doe.gov